

Beautiful Goetzea



Recovery Plan

BEAUTIFUL GOETZEA (Goetzea elegans) RECOVERY PLAN

prepared by

U.S. Department of the Interior
Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

Approved:


Regional Director

Date:

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Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1987. Beautiful Goetzea Recovery Plan.
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EXECUTIVE SUMMARY

1. Point or condition when the species can be considered recovered?

The primary objective of this recovery plan is to provide guidance for reversing the decline of Goetzea elegans and restore the species to a stable, secure, and self-sustaining condition, thereby permitting its reclassification from endangered to threatened status.

Reclassification would be considered when, at a minimum, 1) the principal population in Quebrada Bellaca, Puerto Rico, is placed under protective status, and 2) at least three new, self-perpetuating populations have been established within appropriate units of the Commonwealth Forest System, or on suitable Federal land within the Caribbean National Forest.

2. What must be done to reach recovery?

Protect existing populations and their habitats, and establish new populations at other protected sites in northern Puerto Rico.

3. What specifically must be done to meet the needs of #2?

Protection of existing populations, particularly at Quebrada Bellaca, could be achieved through redesignation of private lands to protective status (e.g., conservation or scenic easements), and/or the development of conservation agreements with landowners. At Quebrada Bellaca, the additional step of fencing to exclude livestock would be necessary. Establishment of new populations would require the study of natural reproductive processes, their application in artificial propagation, and the introduction or reintroduction of plants to ecologically appropriate and adequately protected sites.

4. What management/maintenance needs have been identified to keep the species recovered?

Existing and new populations and their habitats must be protected and managed to permit plant growth, the production of viable seed, and seedling establishment. Concomitantly, there should be a continuing search for new populations in northern Puerto Rico.

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PART I. INTRODUCTION

Beautiful goetzea (Goetzea elegans) is a small evergreen tree endemic to the island of Puerto Rico. Although the species has never been common, it has historically been known to occur at several locations within the karst and foothills regions on the northern side of the island. At present, the species appears to be confined to a single area in the northwest, largely due to extensive deforestation and human occupation of its remaining habitats. Approximately 50 plants are known to survive in three populations, one on privately owned land and the other two on lands owned by the Commonwealth of Puerto Rico.

Goetzea elegans was determined to be an endangered species on April 18, 1985 (Federal Register 50: 15564), pursuant to the Endangered Species Act of 1973, as amended. Critical habitat has not been designated for this species because there is a possibility that the species could be overcollected for scientific purposes and because of its potential ornamental value.

Description

Goetzea elegans, a member of the nightshade family (Solanaceae), was first described by Heinrich Wydler on the basis of material he collected in Puerto Rico in 1827. The type locality is believed to have been Quebradillas in the northwest region of the island, where at least one population is known to exist today. Several other collections of this species were later made at sites elsewhere in northern Puerto Rico, but from which it has since been extirpated.

The only significant disagreement over the taxonomic status of this species concerns the proposed placement of the genus Goetzea, together with four other related genera of Mexico and the West Indies, in the family Goetzeaceae. However, the genus has traditionally been placed in the Solanaceae, and this designation is generally recognized as valid by Caribbean taxonomists (see Vivaldi, et al. 1981). The genus Goetzea is composed of two very similar species: G. elegans, and G. ekmanii, which is endemic to the island of Hispaniola. Although the similarities between these species may warrant further investigation, the fact that G. ekmanii may have been extirpated from Hispaniola heightens concern that, regardless of the species' relationship, the genus Goetzea may be endangered as well.

Goetzea elegans is an evergreen shrub or small tree reaching 30 feet (9 meters) in height with a stem diameter of 5 inches (13 centimeters). The leaves are simple, alternate, and elliptic, with entire margins and shiny dark green upper surfaces. The species generally flowers and sets fruit between April and August. The perfect (bisexual) funnel-shaped flowers are yellow-orange in color, and borne singly on curved stalks arising from the leaf axils. The fruit is an orange, one-seeded berry up to 1 inch (2.5 centimeters) in diameter, and is reputed to be poisonous.

Distribution

Goetzea elegans has been collected at six sites in northern Puerto Rico. Although collection records are not clear, the species is believed to have been discovered in the Quebradillas area to the northwest, near where the largest known population exists today at Quebrada Bellaca. It was found later in the nineteenth century in the northern foothills of the Luquillo Mountains, and again in this century at a site a short distance to the northwest. In 1950, the species was located in Cambalache Commonwealth Forest, in the north-central part of the island. Most recently, three closely grouped populations have been discovered in the Guajataca/Quebradillas area: two on the west side of Guajataca Gorge near the town of Isabela, and the third at Quebrada Bellaca near Quebradillas (Figure 1). All of the known populations except those in the

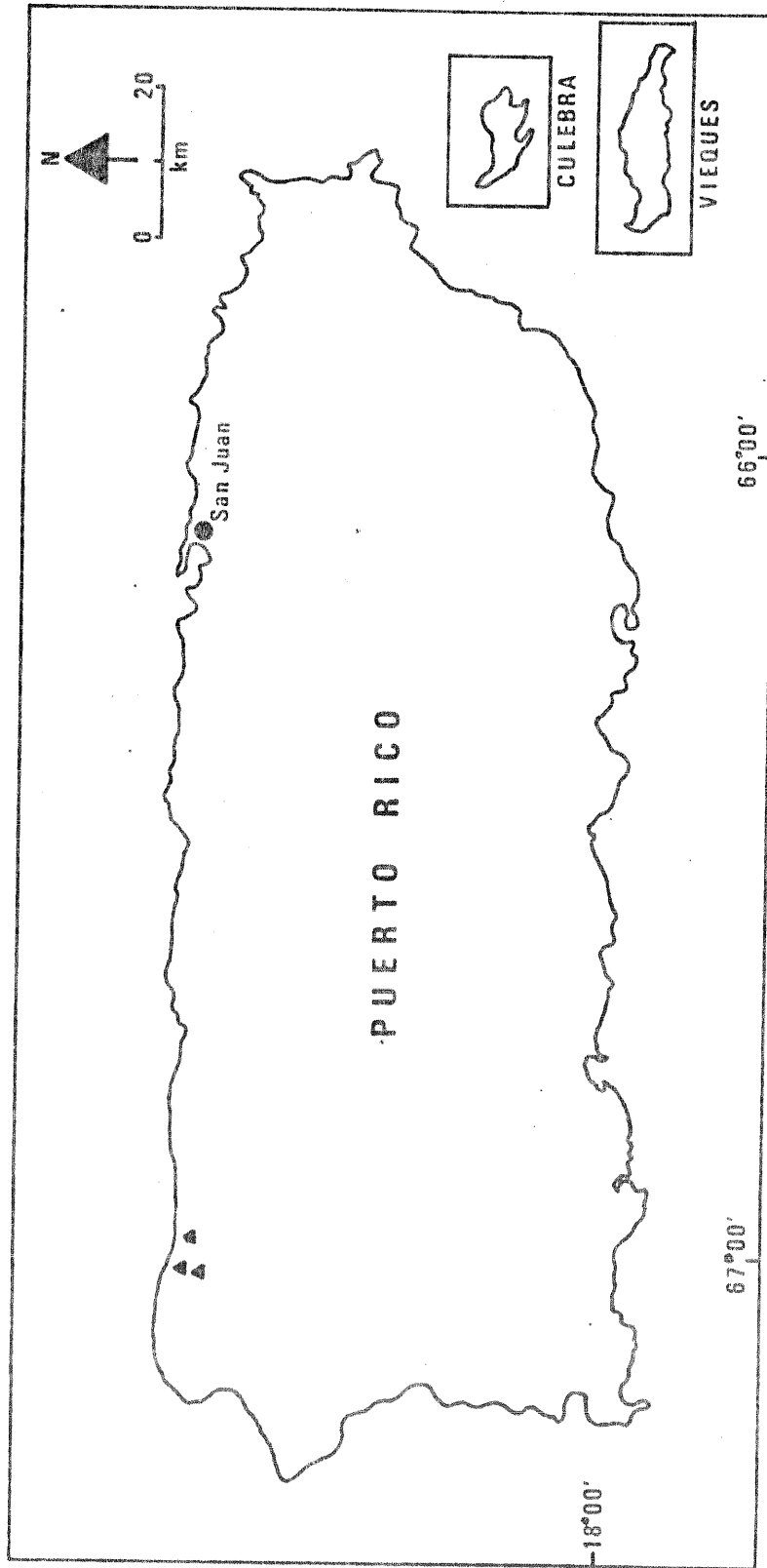


Figure 1. Present distribution of Goetzia elegans. Population locations indicated by (▲).

Guajataca/Quebradillas area have been extirpated since their discovery.

The species appears to have always been rare and local in its distribution (Little, et al. 1974), and it was not encountered during the most extensive botanical survey of the island early in this century (Britton and Wilson 1923).

Population Status

Of the six historical locations where Goetzea elegans has been found, only the three most recently discovered sites in the Guajataca/Quebradillas area have actually been surveyed (Vivaldi, et al. 1981; B. Cintrón, pers. comm.). These sites can be summarized as follows:

1. P.R. Highway 113 (west side of Guajataca Gorge) - approximately 10 individuals persist along both sides of a road right-of-way and adjacent fence line, primarily on Commonwealth land managed by the Department of Transportation and Public Works. A few plants are on adjacent private lands.
2. P.R. Route 2 (west side of Guajataca Gorge) - a population of approximately 17 plants exists on the south side of this principal transportation corridor, less than a mile (about 1 kilometer) south of

the Highway 113 population. The land status is uncertain, but it is believed to be within the right-of-way for Route 2, and thus under Commonwealth jurisdiction.

3. Quebrada Bellaca (east of Quebradillas) - the largest known population of Goetzea elegans is located in this ravine, which crosses several parcels of privately owned land. Two subgroups of this population are separated by P.R. Highway 485. A total of approximately 21 individuals, including some of the largest known specimens, grow along a 1 mile (1.6 kilometer) section of the ravine. The site is about 3.5 miles (5.6 kilometers) east of the two populations described above.

The total number of plants in these three populations is less than 50; however, the plants along Highway 113 have been repeatedly pruned back and have resprouted with multiple stems, thus the number of "individuals" reported to be present may be an overestimate of the actual population size.

Reproductive Status

Beyond what can be surmised from the reproductive morphology and vegetative behavior of Goetzea elegans, nothing is known of the species' reproductive or regenerative capacities. The species produces small but showy yellow-orange flowers which are probably

attractive to both insects and birds. Incidental observations of flowering trees suggest that nectar-feeding birds such as the bananaquit (Coereba flaveola) may be important pollinators. It is also possible that some self-pollination occurs.

Fruit and seed production and frequency have never been quantified. Viable seed is produced at least periodically, since laboratory germination of seeds taken from Quebrada Bellaca has been successful (B. Cintrón, pers. comm.). However, seedlings have rarely been observed in nature. It is possible that fruit production is low, and that those fruits produced are quickly taken by birds or bats, but it is not known whether the seeds are digested or excreted live. Observations of trees during fruit set indicate that what little fruit is produced is either taken directly from the trees or as soon as it falls to the ground, thus providing little opportunity for local recruitment.

The importance of vegetative regeneration to natural population maintenance or expansion is difficult to assess, since only those plants regularly trimmed during road maintenance activities have shown a tendency to resprout or root-sucker. Resprouting may occur when trees are wind-thrown.

It is important to note that, in the case of those plants regularly trimmed during road maintenance, there is a loss of

potential reproductive material (pollen and seed) to the gene pool from this population. Although the plants may survive, individual stems do not develop sufficiently to produce flower buds, thus there is no contribution of genetic information from, or recruitment of offspring to, the parent population.

Habitat Description

Goetzea elegans is restricted to semievergreen forests of the subtropical moist forest zone (sensu Ewel and Whitmore 1973), and has been found only below 660 feet (200 meters) elevation in the foothills and mogotes (karst limestone hills) of northern Puerto Rico. This life zone and associated forest types cover a greater area of Puerto Rico than any other "climatic association" (sens. lat.). However, because of their geographic extent, low elevation, and relatively productive soils, these lands have been nearly totally deforested, and most of the existing forest cover is second-growth.

The annual rainfall of subtropical moist forests reaches 80 inches (2000 millimeters). In Puerto Rico, rainfall is unevenly distributed during the year, with a distinct, bimodal wet season between May and November, followed by an extended dry season. Annual temperatures on the north coast of the island average 25 C, with a seasonal variation of only 3-5 C. High annual temperatures and

incoming solar radiation, together with seasonal rainfall, mean that potential evapotranspiration is high and that available moisture will exceed requirements for plant growth only during the wet season (Ewel and Whitmore 1973).

The limestone karst region of northern Puerto Rico is characterized by undulating topography of relatively low relief, but with typical karst features such as steep, rounded hills ("haystacks"), sinkholes, caves, and subterranean streams (Monroe 1976). The soils are usually limestone-derived, poorly developed, and excessively drained, although a considerable amount of alluvial material originating in uplands of volcanic origin has been incorporated into bottomland soils, which show greater development and higher productivity. On the limestone hills, soil development and moisture capacity decrease with elevation, and most hills are topped with outcrops of the parent Aymamon Limestone.

The semievergreen forests within which Goetzea elegans occurs are typically composed of an overstory of two tree strata, with an open understory and sparse ground cover. As much as two thirds of the upper canopy (usually dominated by Bursera simaruba and/or Bucida buceras) may be deciduous, while the subcanopy species (largely Eugenia, Guaiacum, and Coccoloba spp.) are usually evergreen. Lianas are generally common, while epiphytes are less

evident than in the wetter forests of higher elevations (Vivaldi, et al. 1981).

Considering the profound alteration of forest cover that has occurred in this region over the last two centuries of human occupation, together with the lack of survey data on Goetzea elegans, it is extremely difficult to describe the role or importance of this species within the setting of a natural forest community. Even if one assumes that the composition and relative dominance of the species present today approximates that of the past, the relictual nature of surviving Goetzea elegans populations (i.e., in ravines and along fence lines) prevents accurate assessment of the species' actual habitat requirements and phytosociological relationships. The only general conclusion that can be drawn from the species' present distribution is that it appears to be restricted to mesic sites within the topographic moisture gradients of the limestone hills, and may actually do best along seasonal watercourses.

Known and Suspected Limiting Factors

Historically, the most important factor limiting the distribution of Goetzea elegans has been the nearly complete deforestation of Puerto Rico's lowlands. Most of the level ground has been converted to agriculture, while steeper, less productive land has been utilized

for grazing. The most rugged or inaccessible sites (i.e., hilltops and sinkholes) have been selectively cut for wood to provide construction materials or charcoal. The latter impacts, while having a significant effect on forest habitats, have probably not been sufficient to eradicate all individuals of a particular plant species. Thus, some of Puerto Rico's rarest plants have persisted on the limestone hills of the karst region. Although it is not clear that Goetzea elegans has ever been common, it is likely that the species was more abundant in pre-Columbian times.

More recently, population growth and urbanization have shifted economic emphasis away from traditional agricultural practices toward industrial expansion, with a resultant increase in the construction of high-density housing, roads, and service facilities. Lands formerly in cultivation which might have had the potential to revert to forest have been permanently converted to human use, while other lands supporting second-growth forests are facing a second, more devastating, human threat. Today, not only are forests cleared, but terrain is altered, and in some cases, whole limestone hills are removed to supply construction material, or to make way for housing, factories, and roads. In the future, rare or relictual species such as Goetzea elegans will be less likely to survive these modern threats.

Threats to Future Existence

The remaining populations of Goetzea elegans face a variety of specific threats related to the general problems outlined above. Both populations west of Guajataca Gorge are within or immediately adjacent to the rights-of-way of heavily used transportation corridors. At present, the primary threat to these plants is vegetation clearing or cutting along the edge of the roadway. In the future, resurfacing, widening, or realignment of these roads by the Commonwealth Department of Transportation and Public Works (possibly with support from the Federal Highway Administration) could result in the loss of one or both of these populations.

On private lands, clearing, woodcutting, or increased grazing pressure would all destroy plants or at least limit population growth. In the Quebrada Bellaca, where the largest population of mature Goetzea elegans exists, the possibility of viable seed production and seedling recruitment are highest. However, uncontrolled grazing or trampling by livestock would hinder or prevent successful seedling establishment and growth. In addition, ravines such as the Quebrada Bellaca are often scoured by flash flooding during the wet season, making them poor sites for seedling establishment. Therefore, the greatest importance of this particular population may be as a source of propagative material which might otherwise be lost.

Collecting of Goetzea elegans has not been documented as a factor leading to the decline of the species. Nevertheless, the number of remaining plants is small enough that taking for any purpose could become a threat in the future, particularly if horticultural interest in the species develops (see below).

Cultivation Potential

Although there has been no documented taking of Goetzea elegans for horticultural purposes, the species is a very attractive woody plant with at least some potential for ornamental use. Propagation from both cuttings and seed has been successful on a small scale (J. Popenoe, pers. comm.; B. Cintrón, pers. comm.), and tissue culture has been attempted (Vivaldi, et al. 1981), but as yet no artificially propagated plants have reached reproductive maturity. It is possible that sufficient material can be produced ex situ to provide a source of plants for reintroduction of the species to adequately protected and environmentally suitable sites in northern Puerto Rico.

PART II. RECOVERY

A. Recovery Objective

The objective of this recovery plan is to provide guidance for reversing the decline of Goetzea elegans and restoring the species to a stable, secure, and self-sustaining status, thereby permitting it to be reclassified from endangered to threatened, and perhaps eventually allowing its removal from the Federal List.

Goetzea elegans could be considered for reclassification to a threatened species when 1) the principal population in Quebrada Bellaca is placed under protective status, and 2) at least three new populations capable of self-perpetuation have been established within protected units of the Commonwealth Forest System in the karst region (e.g., Cambalache or Guajataca), or on Federal land within the Caribbean National Forest, if suitable habitat exists. These must be considered minimum requirements, and should be expanded upon if the regenerative potential of natural and ex situ populations proves insufficient. On the other hand, if new populations of mature plants are discovered, it may be preferable to place greater emphasis on protection, rather than propagation, to achieve a minimum number of plants.

B. Step-down Outline

1. Prevent further habitat loss and population decline.
 11. Habitat protection.
 111. Obtain protective status for Quebrada Bellaca.
 112. Develop cooperative agreements with private landowners adjacent to Quebrada Bellaca.
 113. Exclude livestock from Quebrada Bellaca.
 114. Develop cooperative agreement with Puerto Rico Department of Transportation and Public Works.
 115. Determine ownership of other population sites and follow protection guidelines developed for 112. and 114. above.
 12. Plant protection.
 121. Monitor all known populations.
 122. Enforce existing Commonwealth regulations prohibiting take.
 123. Educate the public on plant conservation values and regulations.
2. Continue to gather information on distribution and abundance of Goetzea elegans in northern Puerto Rico.
 21. Continue search for new populations.
 211. Identify and inventory potential sites.
 212. Characterize sites to determine their suitability for future recovery actions.

3. Research.
 31. Define habitat requirements.
 32. Determine reproductive biology and ecology of Goetzea elegans.
 321. Assess periodicity of flowering and pollination mechanisms.
 322. Assess fruit production and seed dispersal.
 323. Evaluate seed viability and germination requirements.
 324. Evaluate seedling establishment and growth.
 325. Evaluate role of vegetative regeneration.
 33. Evaluate feasibility of artificial propagation.
 331. Evaluate relative feasibility of propagation from seed versus cuttings.
 332. Determine feasibility of ex situ production of seed and cuttings.
 34. Select appropriate sites for population enhancement, reintroduction, or introduction using artificially propagated material.
 341. Assess habitat suitability.
 342. Assess site protection.
 3421. Proceed with designation of protective status, if necessary.
 3422. Develop management plans for new sites.

4. Refine recovery goals.
 41. Determine number of populations and individuals necessary to ensure species' stability, security, and self-perpetuation.
 411. Determine relative importance of continued propagation and reintroduction versus habitat protection.
 42. Determine what additional actions, if any, are necessary to achieve recovery goals.

C. Outline Narrative

1. Prevent further habitat loss and population decline.

Habitats and plants at remaining population sites must be protected to prevent species extinction, maintain genetic diversity, and provide sources of propagative material.

11. Habitat protection.

Highest priority must be given to protection of existing population sites.

111. Obtain protective status for Quebrada Bellaca.

Since Quebrada Bellaca supports the only known mature population of Goetzea elegans, every effort should be made to develop alternatives for protection through public or private agencies (e.g., conservation or scenic easement). The area protected should be sufficient to buffer population from activities on adjacent lands.

112. Develop cooperative agreements with landowners adjacent to Quebrada Bellaca.

In addition to 111. above, owners of private lands adjacent to the Quebrada Bellaca site should be contacted and alerted to the problem.

If agreement can be reached, a cooperative management plan should be developed which prevents or limits actions which might be deleterious to the population (e.g., livestock or erosion control).

113. Exclude livestock from Quebrada Bellaca.

Regardless of the ultimate status of this site or the degree of landowner cooperation achieved, it will be necessary to exclude livestock from the quebrada by fencing sections where natural contours are not sufficiently steep (i.e., near vertical) to otherwise exclude them.

114. Develop cooperative agreement with Commonwealth Department of Transportation and Public Works.

In some cases, periodic road maintenance may not involve Federal support. Agreement should be reached with the Department of Transportation to protect roadside plants (i.e., along Route 2 and Highway 113) from destruction or pruning.

115. Determine ownership of other population sites and follow protection guidelines developed for 112. or 114. above.

The exact location of some individual plants on Route 2 and Highway 113 should be determined so that the landowner can be identified (private or Commonwealth), and appropriate action taken to protect the plants.

12. Plant protection.

In addition to habitat protection, the continued health and survival of individual plants within each population should be monitored and steps taken to prevent human disturbance.

121. Monitor all known populations.

All known populations of Goetzea elegans should be monitored at regular intervals to determine mortality (natural or human-related), observe phenology and reproductive events, assess recruitment, and identify changes in site conditions (natural or human-related).

122. Enforce existing Commonwealth regulations prohibiting take.

The Commonwealth's 1985 Regulation to Govern

the Management of Threatened and Endangered Species provides for criminal penalties for illegal take of listed plant species, regardless of land status. Goetzea elegans is on the Commonwealth list, and the regulation must be enforced with regard to this species.

123. Educate the public on plant conservation values and regulations.

Federal and Commonwealth conservation agencies should take the lead in educating the public on general conservation values, with emphasis on the importance of protecting endangered plants and the existence of Federal and Commonwealth laws prohibiting collecting and vandalism.

2. Continue to gather information on distribution and abundance of Goetzea elegans in northern Puerto Rico.

Decisions regarding management of existing populations and recovery priorities will be affected by the species' abundance.

21. Continue search for new populations.

The karst region and foothills of northern Puerto Rico are sufficiently rugged that the likelihood of

undiscovered populations of Goetzea elegans remains high.

211. Identify and inventory potential sites.

There should be a systematic evaluation and inventory of all potential population sites in northern Puerto Rico.

212. Characterize sites to determine their suitability for future recovery actions.

Where new populations are discovered, not only should new ecological and biological information be added to the existing data base, but each site should also be evaluated to determine its value as a source of propagative material and its potential for protection. If no plants are present, the suitability of the site for introduction of the species should be determined.

3. Research.

Although the benefits of research are primarily long-term, there is so little information available on Goetzea elegans that many studies can be directed at the near-term needs of the species.

31. Define habitat requirements.

Using information gained from the study of known population sites, together with any additional information obtained from new sites, the habitat requirements of Goetzea elegans should be more clearly defined. Qualitative and quantitative data on site conditions (moisture, soils, microclimate, biotic associations, etc.) must be gathered to guide site and species management decisions.

32. Determine reproductive biology and ecology of Goetzea elegans.

The scarcity of knowledge on the reproductive biology of this species limits management of existing populations and delays establishment of new populations.

321. Assess periodicity of flowering and pollination mechanisms.

Flowering has not often been observed in this species, but this may be an artifact of limited observations of the species in general. It is necessary to determine the frequency with which flowering occurs, and the physical or

biological factors which control its timing and abundance. In addition, the species' pollination mechanisms should be identified, and requirements for their maintenance included in the development of management plans.

322. Assess fruit production and seed dispersal.

The proportion of flowers that ultimately develop into fruit, and the fate of fruit and their seed should be assessed. Fruit predators and/or seed dispersal agents, and the conditions under which seed is successfully dispersed to "safe sites" (i.e., sites that are physically and biologically suitable) should be identified.

323. Evaluate seed viability and germination requirements.

It is necessary to evaluate the proportion of seed produced which are viable (based on embryo development or germinability), and the environmental conditions (including dispersal agents) required for germination. This would include both laboratory and field germination experiments.

324. Evaluate seedling establishment and growth.

Conduct field experiments in conjunction with 323. above to determine suitable microsite conditions for seedling establishment and factors affecting seedling survival, the most critical stage in recruitment.

325. Evaluate role of vegetative regeneration.

Determine what role, if any, vegetative regeneration plays in population maintenance and expansion. Assess relationships between "individuals" at known sites to determine their origins.

33. Evaluate feasibility of artificial propagation.

Continue present work on artificial propagation from both cuttings and seed. This should include a preassessment of effects on the source population, particularly where seed collection is involved.

331. Evaluate relative feasibility of propagation from seed versus cuttings.

Based on the availability of propagative material, economic and logistical considerations, and field success, determine the most feasible methods of propagation and transplantation to existing or new sites.

332. Determine feasibility of ex situ
production of seed and cuttings.

Determine whether there is sufficient live material in ex situ cultivation to provide a less destructive source of propagative material for use in the field.

34. Select appropriate sites for population enhancement, reintroduction, or introduction using artificially propagated material.

The success and ecological relevance of planting or transplanting propagative material depend upon adequate consideration of geography and habitat.

341. Assess habitat suitability.

Using information gained in 31. above, inventory potential sites to determine their suitability for supporting new or additional plantings of Goetzea elegans.

342. Assess site protection.

In addition to a suitable environment, the feasibility of site protection must also be considered.

3421. Proceed with designation of protective status, if necessary.

If sites proposed are not already on protected land, steps must be taken to alter the status of such land to provide protection for new species' populations.

3422. Develop management plans for new sites.

In accordance with guidelines established in 111., 112., and 114. above, develop appropriate plans for management of new sites. If the site is already within an existing management area, existing plans should be modified to consider the presence and needs of this species.

4. Refine recovery goals.

As additional information on the biology, ecology, and propagation of Goetzea elegans is gathered, it will be necessary to better define, and possibly modify, recovery goals.

41. Determine number of populations and individuals necessary to ensure species stability, security, and self-perpetuation.

Based on environmental and reproductive studies, together with the relative success of population

protection measures, more precise and realistic recovery goals for this species can be established.

411. Determine relative importance of continued propagation and reintroduction versus habitat protection.

It is particularly important that there be some shift in emphasis from propagation to protection if new, self-sustaining populations are discovered.

42. Determine what additional actions, if any, are necessary to achieve recovery goals.

If there are any actions not included in this recovery plan which, during the recovery process become recognized species' needs, they must be incorporated into the plan.

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PART III. IMPLEMENTATION SCHEDULE

Priorities in Column 4 of the following Implementation Schedule are assigned as follows:

- Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
- Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.
- Priority 3 - All other actions necessary to provide for full recovery of the species.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULE

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Implementation Schedule

Beautiful Goetzee (Recovery Priority #5)

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	Division	Other	FY 1	FY 2	FY 3	
A-2,3,6	Protective status for Quebrada Bellaca	111	1	5 yrs.	4	SE	PRDNR, CTPR				
M-3 A-3	Cooperative agreements with landowners adjacent to Quebrada Bellaca	112	1	2 yrs.	4	SE	PRDNR, CTPR				
M-3,5	Exclude livestock from Quebrada Bellaca	113	1	2 yrs.	4	SE	PRDNR	10K	10K		
M-3 A-3	Cooperative agreement with PR Dept. of Transportation	114	1	1 yr.	4	SE	PRDNR, PRDTPW				
I-14	Determine ownership of other sites	115	2	Ongoing	4	SE	PRDNR, PRDTPW				
I-1 M-3	Monitor all known populations	121	1	Ongoing/Continuous	4	SE	PRDNR				
O-2,3	Enforce Commonwealth regulations prohibiting take	122	1	Ongoing/Continuous	4	SE,LE	PRDNR				
O-1	Educate public on plant conservation values and regulations	123	2	Continuous	4	SE	PRDNR	1K	1K	1K	
I-1,2	Continue search for new populations	21	2	Continuous	4	SE	PRDNR	1K	1K	1K	
R-3	Define habitat requirements	31	2	3-5 yrs.	4	SE	PRDNR, Univ.	2K	2K	2K	

Implementation Schedule

Beautiful Goetzia

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes	
					FWS	Region	Division	Other	FY 1	FY 2		FY 3
R-6,14	Determine reproductive biology and ecology	32	2	3-5 yrs.	4	SE	Univ.	15K	15K	15K	Costs would also include Tasks 321, 322, 324, and 325	
R-14	Assess periodicity of flowering and pollination mechanisms	321	2	3-5 yrs.	4	SE	Univ.					
R-14	Assess fruit production and seed dispersal	322	2	3-5 yrs.	4	SE	Univ.					
R-7,14	Evaluate seed viability and germination requirements	323	2	3-5 yrs.	4	SE	Univ., BotGar	5K	5K	5K		
R-6,14	Evaluate seedling establishment and growth	324	2	3-5 yrs.	4	SE	Univ.					
R-6,7	Evaluate role of vegetative regeneration	325	2	2 yrs.	4	SE	Univ.					
M-1,2	Evaluate feasibility of artificial propagation	33	2	Ongoing/Continuous	4	SE	BotGar	1K	1K	1K	Costs would also include Tasks 331 and 332	
M-1	Evaluate relative feasibility of propagation from seed vs. cuttings	331	2	Ongoing/Continuous	4	SE	BotGar					
M-1	Determine feasibility of ex situ production of seed and cuttings	332	2	Ongoing/Continuous	4	SE	BotGar					

Beautiful Goetzee
Implementation Schedule

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS	Other		FY 1	FY 2	FY 3	
						Region	Division				
M-2,3	Select sites for enhancement, reintroduction, or introduction of propagated material	34	3	Continuous	4	SE	PRDNR, USFS				If former sites now on National Forest land are selected, USFS would become involved
I-2 M-3	Assess habitat suitability	341	3	Continuous	4	SE					
M-3,5 A-2,3,6	Assess site protection	342	3	Continuous	4		PRDNR, USFS, CTPR				
I-1	Determine number of populations and individuals necessary to perpetuate species' existence	41	3	5 yrs.	4	SE	PRDNR, BotGar, Univ.				
I-4	Determine additional actions necessary to achieve recovery goals	42	3	5 yrs.	4	SE	PRDNR				

LIST OF ABBREVIATIONS

BotGar = botanical gardens
 CTPR = Conservation Trust of Puerto Rico
 LE = Division of Law Enforcement, FWS
 PRDNR = Puerto Rico Department of Natural Resources
 PRDTPW = Puerto Rico Department of Transportation and Public Works
 SE = Endangered Species Program, FWS
 Univ. = Universities
 USFS = U.S. Forest Service

PART IV. APPENDIX

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